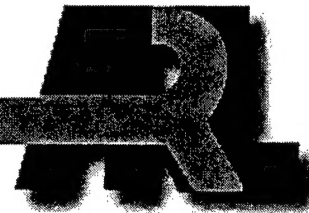


ARMY *RESEARCH* LABORATORY



Development of Improved Performance  
Research Integration Tool (IMPRINT)  
Performance Degradation Factors for the  
Air Warrior Program

Lucia Salvi

ARL-TR-2311

JANUARY 2001

20010328 066

Approved for public release; distribution is unlimited.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citation of manufacturer's or trade names does not constitute an official endorsement or approval of the use thereof.

Destroy this report when it is no longer needed. Do not return it to the originator.

# **Army Research Laboratory**

Aberdeen Proving Ground, MD 21005-5425

---

ARL-TR-2311

January 2001

---

## **Development of Improved Performance Research Integration Tool (IMPRINT) Performance Degradation Factors for the Air Warrior Program**

Lucia Salvi  
Human Research & Engineering Directorate

---

Approved for public release; distribution is unlimited.

---

---

## Abstract

---

The Human Research & Engineering Directorate of the U.S. Army Research Laboratory was asked by the Program Manager for Aircrew Integrated Systems (PM ACIS) to examine the effects of clothing and individual equipment (CIE) and aircrew life support equipment (ALSE) on the performance of Army aviators. These effects were quantified in terms of the additional time needed to perform certain types of tasks as a direct result of the equipment and ensembles. Through the completion of detailed questionnaires by subject matter experts, estimates of performance were collected and analyzed, and a set of performance degradation factors was developed.

This methodology was developed in concert with the modeling tool, the Improved Performance Research Integration Tool (IMPRINT), in order to predict the effects of CIE and ALSE on mission- and system-level performance through detailed computer modeling. This methodology demonstrated success in converting otherwise subjective data into a quantifiable and generalizable modeling approach.



## ACKNOWLEDGMENTS

The author wishes to express gratitude and acknowledge the contributions of Mr. Richard Adkins, Dynamics Research Corporation. Mr. Adkins was instrumental in providing historical information regarding the original stressors in the Improved Performance Research Integration Tool (IMPRINT) and was able to help the author develop a compatible methodology for the Air Warrior Program. Mr. Adkins was also responsible for analyzing the contributions of the individual equipment items to the total ensemble performance degradation, and he is commended for this effort. The author thanks Dr. Laurel Allender and Mr. David Harrah of the U.S. Army Research Laboratory's (ARL's) Human Research and Engineering Directorate (HRED) for their guidance throughout the project and for their technical review of the manuscript. The author acknowledges Mr. Richard Tauson of ARL's HRED for scheduling the group interviews and for allowing the data collection effort to follow these sessions and for his technical review of the manuscript. Thanks also to Dr. Edward Davis of ARL's Survivability/Lethality Analysis Directorate for his thorough review of the manuscript and insightful comments.

INTENTIONALLY LEFT BLANK

---

## Contents

---

1.	Introduction .....	1
2.	Background .....	2
3.	Method .....	4
3.1	Approach .....	4
3.2	Questionnaire Development .....	5
3.3	Questionnaire Administration .....	7
4.	Results and Discussion .....	7
4.1	Demographic Data .....	8
4.2	Data Organization .....	9
4.3	Performance Degradation Factor Development .....	9
4.4	Overall Comfort Ratings .....	10
4.5	Reasons Associated With Degraded Performance .....	11
4.6	Analysis of Contributions of Individual Items to Ensemble Degradations .....	13
4.7	Implications of NBC Mask Results .....	14
5.	An Example of Applying the Performance Degradation Factors .....	16
6.	Preliminary Validation of Performance Degradation Factors .....	17
7.	Conclusions .....	20
7.1	Methodology .....	20
7.2	Recommendations .....	20
	References .....	23

## Appendices

A.	Questionnaire and Instructions .....	27
B.	Listings of Specific Equipment Identified With Each Group Interview Session .....	59
C.	Frequency Counts for the Reasons Associated With the Equipment Items and Ensembles and Their Respective Degradations .....	63
	Distribution List .....	69
	Report Documentation Page .....	75

## Tables

1.	Five IMPRINT Stressors by Taxon .....	3
2.	Questionnaires by Unit, Location, and Aircraft .....	8
3.	Ranks of Participants .....	9

4. Equipment Items and Indicated Taxon Degradation . . . . .	11
5. Equipment Items and Modal Performance Degradation Factors by Taxon . . . . .	12
6. Equipment Items and Overall Comfort Ratings . . . . .	12
7. Most Frequently Given Reasons Associated With Taxon Performance Degradations . . . . .	13
8. Mapping of IMPRINT Taxons to BRL Human Ability Codes . . . .	19
9. Comparison of IMPRINT MOPP IV PDFs to Air Warrior PDFs for NBC Ensemble and NBC + Armor Ensemble . . . . .	19

# DEVELOPMENT OF IMPROVED PERFORMANCE RESEARCH INTEGRATION TOOL (IMPRINT) PERFORMANCE DEGRADATION FACTORS FOR THE AIR WARRIOR PROGRAM

---

## 1. Introduction

---

Over the years, Army aviators have acquired and adapted clothing and individual equipment (CIE) and aircrew life support equipment (ALSE) for both routine and mission-specific scenarios. Historically, these items were developed by different organizations to meet specific requirements such as fire retardation, protection from weather, or protection from chemical environments. Although these items work well individually, they often fall short in terms of working as a fully integrated set because they were not designed to work as a system. This twofold effort identified problematic CIE and ALSE as well as quantified the degradation effects in terms of increased time to perform certain types of tasks.

The Program Manager for Aircrew Integrated Systems (PM ACIS) asked the U.S. Army Research Laboratory (ARL) to examine the effects of CIE and ALSE on Army helicopter pilots and crews in four separate but related efforts. One effort involved using an anthropometric human figure modeling software, "Transom Jack" (Badler, Phillips, & Webber, 1993) to develop models of range of motion and reach envelopes within the Apache cockpit (Kozycki, 1998). Another effort used questionnaires with behavior-anchored ratings to address various issues such as the effects of mission-oriented protective posture (MOPP) gear in cockpit simulators (Waugh et al., 1999). A third effort involved interviewing aircrew personnel in a semi-structured format to determine which items were currently acceptable, which items needed modification or replacement, and whether redesigns or procurements done at the local level could be adapted as the Army standard (Tauson, Doss, & Harrah, 1997). The fourth effort, conducted largely in conjunction with the semi-structured interviews and documented in this report, was to examine the effects of CIE and ALSE on the operational performance of Army aviators. These effects were quantified in terms of the additional time needed to perform selected types of tasks as a direct result of the CIE and ALSE. Estimates of the increased time to perform were solicited from subject matter experts (SMEs) (i.e., U.S. Army aviators) through the completion of a detailed questionnaire. The estimates were then compiled and analyzed, and a set of performance degradation factors (PDFs) was developed. These PDFs were then used as pre-processors for the task network-modeling tool, Improved Performance Research Integration Tool (IMPRINT), to predict the effects of CIE and ALSE on mission- and system-level performance through detailed computer modeling. This methodology had a twofold outcome:

- Helped identify problems with current equipment, and

- Facilitated future comparison and evaluation of proposed equipment configurations.
- 

## 2. Background

---

IMPRINT, developed by the Human Research & Engineering Directorate of ARL, is a stochastic task network modeling tool designed to help assess the interaction of soldier and system performance throughout a system's life cycle, from concept and design phases, through field exercises and system improvements. IMPRINT is discussed in detail in an ARL technical paper by Allender and others (1994). Incorporation of task analysis, workload modeling, embedded personnel characteristics data, and performance-shaping and degradation functions and stressors makes it a flexible and unique analytical tool. Degradation functions and stressors are conditions that impede or moderate human performance. A detailed discussion of the IMPRINT degradation functions and stressors is provided in a technical paper presented at a North Atlantic Treaty Organization (NATO) conference by Allender, Salvi, and Promisel (1997).

An IMPRINT analysis fundamentally builds upon a task analysis, which is a standard human factors approach. Initially, a system mission is decomposed into functions, and those functions are further decomposed into tasks. An intricate and complex branching logic determines how the functions and tasks are connected at their respective levels, indicating whether functions and tasks are repeated, performed simultaneously, serially, or probabilistically. It is at the basic task level, the lowest level, where detailed information such as accuracy and time data resides. In order to access the stressor capability in IMPRINT, a task must be even further defined by "taxons." In IMPRINT, taxons are used to describe or categorize a task. Every task can be categorized with as many as three taxons, which depict inherent task characteristics. For example, the task *repositioning a helicopter in flight* may involve *maneuvering the aircraft*, which is classified as fine motor continuous, and *giving or receiving information by radio*, which is classified as communication (oral). Additionally, a weighting scheme is used to describe the degree to which a particular task manifests a particular taxon. In the previous example, *repositioning a helicopter in flight*, the task might be composed of 75% (.75) fine motor continuous and 25% (.25) communication (oral). The weightings of the taxons for each task must sum to 100% (1.00). IMPRINT applies the environmental stressors or PDFs proportionally with respect to the taxons associated with each task.

IMPRINT currently models the degrading effects on performance of various stressors, namely, MOPP gear, heat, cold, noise, and sleep deprivation. These effects are manifested as increased time to perform a task or as decreased accuracy, or in the case of sleep deprivation, both. As indicated in Table 1, not

all types of tasks are affected by all the stressors. This is not to imply that there are no possible effects on these task types but rather that there were limitations in data availability at the time of IMPRINT development. Although the best available data and research were used, they may not have been all inclusive for a number of factors. One reason is that studies may have focused on certain types of tasks, thereby leaving a void for the balance of task types.

Table 1. Five IMPRINT Stressors by Taxon

Taxon	Stressor				
	MOPP	Heat	Cold	Noise	Sleep deprivation
Visual	T	A	T		
Numerical		A			TA
Cognitive		A			TA
Fine motor discrete	T	A	T		
Fine motor continuous					
Gross motor light	T		T		
Gross motor heavy					
Communication (read & write)		A			
Communication (oral)	T	A		A	

T = affects time only

A = affects accuracy only

TA = affects task time and accuracy

Efforts are currently under way to identify research that can be used to validate, revise, and expand the current stressors to fill these voids. Research areas that point to new stressors that are of interest and could potentially be incorporated into IMPRINT are also being identified. A comprehensive literature search conducted by MicroAnalysis and Design (MA&D) and Dynamics Research Corporation (DRC) suggests that there are some new stressors that affect human performance and are potential candidates for inclusion in IMPRINT: vibration, circadian rhythm, altitude, and nuclear, biological, chemical (NBC) contamination. Also, some of the existing embedded stressors (specifically, sleep deprivation and MOPP effects on accuracy) can be revised and expanded (DRC and MA&D, 1999). However, for the most part, the data gaps shown in Table 1 are still valid because there is no supporting research to fill these gaps at this time. There is a lack of quantitative human performance data that are compatible with IMPRINT's data structure and format and can be readily implemented. Table 1 details IMPRINT task types or taxons and their associated stressors. It also indicates whether task performance is degraded by time (T), accuracy (A), or both (TA).

PDFs function as multiplicative values for time or accuracy. Therefore, the degradation factors affecting time will be greater than 1.0 in order to increase the performance time. On the other hand, the degradation factors affecting accuracy will be less than 1.0 in order to decrease the performance accuracy from the pre-existing level. The overall degradation resulting from a specified stressor is directly proportional to the weighting assigned to the affected taxon(s) that the task comprises.

IMPRINT's capability to model degraded performance pertaining to the full range of environmental states provides the modeling infrastructure for evaluating the effectiveness of aircrew CIE and ALSE. However, IMPRINT's current level of detail is inadequate for assessing the effects of individual equipment items. Therefore, the present study was conducted.

---

### 3. Method

---

#### 3.1 Approach

The approach was to collect subjective rating data for the estimated degradation effects of individual items of clothing, equipment, and ensembles on the time to perform different types of tasks. These data were collected in tandem with another part of ARL's Air Warrior effort involving semi-structured group interviews with aircrews to identify specific equipment problems and discuss the ramifications of these problems and possible solutions (Tauson et al., 1997). In addition, because of resource constraints, it was not feasible to collect empirical data about the effects of CIE and ALSE on task performance. Earlier human factors research used questionnaires to gather performance degradation estimates; in fact, some notable work conducted by the Defense Nuclear Agency (DNA) is worth mentioning here. The DNA developed questionnaires to solicit task time estimates for conducting selected combat activities during perceived stressor conditions from groups of SMEs. The stressor conditions undergoing study were various levels of radiation exposure and contamination by chemical agents, where direct study, of course, was prohibited. This work is discussed in detail in a report by Anno, Dore, and Roth (1996). Anno and co-workers found good inter-rater reliability for their particular instrument, which was then used as a model for the work reported here.

The conventional measures of performance for military tasks are usually time or accuracy, although some degree of interdependency is expected. Although both of these performance measures can be used as model parameters in IMPRINT, the focus of this study was solely on the time parameter. Again, the DNA work is cited as a precedent:



Previous DNA/Intermediate Dose Program (IDP) questionnaire efforts found that accuracy is a difficult concept for soldiers to relate to in their roles as SMEs, especially as they view many of the tasks they perform as either being "completed" or "not completed," without specifically accounting for delays that might be due to reduced accuracy.

It was thus concluded that in order to obtain reliable and consistent estimates from SMEs, task performance estimates would be confined to time only. Therefore, based on the DNA work and supporting evidence that questionnaires are relatively inexpensive to administer, provide fast feedback, and can be used in conjunction with previously scheduled semi-structured SME group interviews, it was decided that a questionnaire would be an appropriate vehicle to collect time performance degradation estimates for the IMPRINT modeling effort.

### 3.2 Questionnaire Development

Although there is an officially prescribed list of CIE and ALSE, it was believed at the outset that Army aviation units tailor the set to fit local needs, and this was subsequently found to be the case in this study. Therefore, in order to accommodate any mission-specific or unique equipment items that a given aviation unit used, the questionnaires were designed to be administered after semi-structured group interviews were conducted for the third ARL Air Warrior effort. During these group interviews, listings of the specific equipment items used by that unit were developed. (The information gathered during these group interviews is documented in an ARL report by Tauson et al. [1997]). The questionnaires could thus be individually tailored to the respective units.

Questionnaires consisted of a demographics section and 26 separate rating sheets—one sheet for each equipment item or ensemble identified during the interview. The questionnaire was designed to collect four types of data items relative to each clothing or individual equipment item. A complete copy of the questionnaire and instructions is presented in Appendix A.

The first data item designated whether the equipment item was standard or mission specific. For the purpose of this study, a "standard" item was defined as an item that an Army aviator would typically wear as part of his daily ensemble. A "mission-specific" item was defined as special equipment used to support a specific mission, such as over water, night, ballistic, or chemical threat. Following is the actual excerpt from the questionnaire.

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Then, in order to capture an overall comfort rating for the clothing or equipment, even in the absence of time degradation estimates, an "overall equipment rating" selected from the ten reasons listed was noted. For example, a piece of clothing could conceptually be labeled as uncomfortable or painful, yet it may not have a

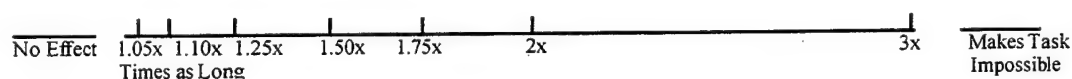
negative impact on the actual time required to perform a certain type of task. The ten reasons listed in the questionnaire were bulky, hot, cold, uncomfortable, heavy, painful, annoying, restrictive, incompatible, and other. Respondents could either select from these 10 reasons or write their own descriptor after selecting the "other" reason. Following is the actual excerpt from the questionnaire.

Overall Equipment Rating: Bulky, Hot , Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other\_\_\_\_\_

Following the qualitative data sections were the quantitative estimates. This section of the questionnaire provided the critical link between the SME estimates and the IMPRINT performance stressors: Performance time degradation estimates for each of nine task types were solicited. The nine task types corresponded directly to the taxons used in IMPRINT (see Table 1).

To ensure comprehension and uniformity among participants, each questionnaire contained definitions of these nine task types, along with some aviation-specific examples. For instance, a "fine motor continuous" task is defined as one that requires uninterrupted performance of an action needed to keep a system on a desired path or in a specific location. Examples would be maneuvering the helicopter in terrain flight and tracking a moving target. Refer to Appendix A to review the definitions and examples of the nine task types that were provided to the participants, along with the questionnaire.

Associated with each one of these nine types of tasks was a rating scale with nine choices representing the possible effects of the particular equipment item on the time to perform this type of task. The choices were no effect; 1.05, 1.10, 1.25, 1.50, 1.75, 2.00, or 3.00 times as long (which is the same as a 5%, 10%, 25%, 50%, 75%, 200%, or 300% increase); or the task was impossible to perform. "Tick" marks designated each of the seven time increase choices, and the two extremes, "no effect" and "makes task impossible" were shown at opposite ends of the scale. Tick spacing was deliberately set to imply variability with respect to the intervals. Following is the actual diagram that was used in the questionnaire.



If an increase in time was designated or the task was noted as impossible to perform, then the qualitative reason(s) were marked and rank ordered in terms of importance, with 1 being the foremost reason and 2 being the secondary reason, and so on. In other words, no limit was set to the number of reasons that might be selected. The 10 reasons listed for each task type were the same as the "overall equipment rating" descriptors. These data items were repeated for each of the CIE and ALSE items and ensembles.

### 3.3 Questionnaire Administration

Three ARL interviewers met with each group and explained the purpose of the Air Warrior program and the overall goals of this effort. Immediately following the informal, semi-structured group interview in which equipment items specific to the group were identified and discussed in detail, the participants were briefed about the specific nature and purpose of the questionnaire. How the data would be used in the IMPRINT modeling effort and the importance of their frank responses was emphasized. Participants were instructed how to base their questionnaire responses. When rating mission-specific equipment items, participants were instructed to compare their performance while wearing the mission-specific items to their performance while wearing the standard items. They were also instructed to rate the standard equipment items in terms of how they negatively affect their performance, if there was a negative effect. The full instructions were then read and reviewed in detail, and questions were encouraged and answered throughout the questionnaire administration period to assure full comprehension. The questionnaires were self-administered in that, after distribution to each of the participants, each respondent recorded his or her own answers.

Since each questionnaire sheet was marked initially with generic items but needed to refer to the specific equipment item or ensemble identified through the group interviews, each group was walked through the questionnaire completion one page or equipment item at a time. Specific equipment items were recorded on the sheet by the participants and then rated. This process was instrumental in keeping each group's responses organized. For instance, the ARL interviewer identified equipment item No. 14, masks, as either the M24 or the M43, depending on which mask was identified in the group interviews. Appendix B provides a full listing of the identified equipment items per unit.

---

## 4. Results and Discussion

---

Questionnaires were administered and completed by 47 participants, both aviators and crewmen, from several locations throughout the country.<sup>1</sup> Of the 47 participants, 39 were pilots. All participants were active duty military except for the one member of the North Carolina Air National Guard. Additionally, all study participants were currently qualified on their aircraft. Each group was composed of pilots or a mix of pilots and crew chiefs, depending on the aircraft. Table 2 lists the units and locations, types of aircraft, and the number of questionnaires that were administered at each site.

---

<sup>1</sup>Since an ARL interviewer administered the questionnaires on a group-by-group basis, return should not have been an issue. One group, however, spent all their allotted time discussing the nuances and problems with their gear and ran out of time for questionnaire administration. Questionnaires were distributed to this group anyway; however, none of these were ever completed and returned.

Of particular interest is the Apache aircraft since modeling efforts capitalized on an existing IMPRINT Apache model. As indicated in Table 2, many of the questionnaires, 22 of the 47, were completed by Apache pilots.

Table 2. Questionnaires by Unit, Location, and Aircraft

Unit	Location	Aircraft	Number of questionnaires
101st	Ft. Campbell, KY	UH-60	3
		AH-64A <sup>a</sup>	3
		AH-64 <sup>a</sup>	7
160th	Ft. Campbell, KY	AH-6	3
		AH-6J	2
		MH-60K	4
		MH-47E	4
		MH-47	1
		MH-60	1
227th	Ft. Hood, TX	AH-64 <sup>a</sup>	3
		AH-64A <sup>a</sup>	2
		UH-60	3
		UH-60L	1
10th Cav	Ft. Hood, TX	OH-58D	3
229th	Ft. Bragg, TX	AH-64 <sup>a</sup>	4
		AH-64A <sup>a</sup>	2
130th	North Carolina NG	AH-64 <sup>a</sup>	1
Total			47

<sup>a</sup>indicates Apache aircraft

Although the questionnaires were labeled with 26 generic equipment items or ensembles, an average of 25 or fewer pieces of equipment or ensemble combinations was actually identified for each group or unit. The actual listing of equipment items and ensembles that were identified is reported in Appendix B.

#### 4.1 Demographic Data

The participants ranged in age from 23 to 49 years; the average age was 31 years. The average number of years in aviation was 8 years, with a minimum of 2.5 years and a maximum of 21 years. The average total flying hours logged was 1,385.5, with a minimum of 200 hours and a maximum of 6,200 hours. The high degree of variability indicated that the sample represented a broad spectrum of aircrew, from the novice to the experienced. The ranks of the participants are listed in Table 3.

Table 3. Ranks of Participants

Rank	Number of participants
CPT	1
1LT	2
2LT	1
CW4	2
CW3	6
CW2	26
SFC	1
SSG	3
SGT	2
SPC	1
CPL	1
Unknown	1

#### 4.2 Data Organization

The analysis of the questionnaire responses involved several steps. Because of the magnitude of the data collected, the most effective way to manage the raw data responses was to create 25 separate SPSS<sup>®2</sup> databases to correspond with the 25 identified equipment items and ensembles. The spreadsheets were self-contained in that each of them was populated with full demographic data, an overall equipment rating, and all the task time degradation estimates for each of nine task types and the associated reasons for those performance degradations.

Although participants were instructed to select one of the given time choices for degradation, respondents occasionally marked an area between two choices. To preclude inflated results, the lower number was selected as the response. In this way, the error was placed on the side of underestimation rather than overestimation. Each database was developed in a 27 by 47 matrix format. For each of the 26 pieces of equipment or ensembles, 47 subject responses for 27 variables (a total of 1,269 data items) were recorded: eight demographic data elements (rank, age, unit, years in aviation, type of aircraft qualified on, hours logged, crew position); an overall comfort rating; ratings of degradation for each of the nine task types; and reasons associated with the degradation for each of the nine task types.

#### 4.3 Performance Degradation Factor Development

In order to maintain compatibility with the original IMPRINT embedded stressors, the author consulted DRC for the development of the Air Warrior PDFs. DRC was responsible for both the development and implementation of the

<sup>2</sup> Not an acronym

original stressors, dating back to the 1980's, and was able to make recommendations for this study as well. As a first step in the analytical process, frequency distributions were examined for each equipment item or database. A criterion was then developed to identify those items and ensembles that were associated with degradations in performance by most participants (i.e., more than 50%). Therefore, if 50% or more of respondents indicated that there was no effect on the performance time, then that item was not considered to be degrading to performance. If, however, more than 50% of respondents indicated some level of performance degradation, then that item was considered to have a degrading effect on performance and was further analyzed.

This portion of the analysis resulted in the identification of ten items or ensembles that were classified as causing degradation in performance by more than 50% of respondents (see Table 4). These items were Mustang suit (over-water anti-exposure suit); NBC overshoes; liners for hands; cold weather glove; NBC overglove; NBC mask; raft; body armor; NBC ensemble; and NBC plus armor ensemble. Interestingly, 100% of the respondents indicated degradation in performance associated with the NBC mask. The importance and implications of this finding are discussed later in this report.

For the ten items listed in Table 4, frequencies for time degradation estimates for each task type were computed. As a measure of central tendency, the mean values of the time estimates were initially examined. However, for the following two reasons, the mean values were not used as the PDFs. First, several of the aviators consistently indicated very high time degradation estimates for every data item, which disproportionately influenced the values of the means. To avoid skewing the mean values with the inclusion of these few outlier data points, the modal values, which are analogous to a group consensus, were chosen. Secondly, since the "impossible to perform" choice was not associated with a numerical value, these selections could not have been mathematically averaged. The modal (most frequently occurring) value was found to better represent the degradation effects of the equipment and clothing items on each task type and eliminated the effects of extreme values. Table 5 lists the equipment item with the task type descriptors or "taxons" and their associated degradation factors.

#### **4.4 Overall Comfort Rating**

Table 6 lists the overall comfort ratings given for each equipment item, regardless of task type. When more than one descriptor is listed, they had equal frequencies and were tied for first place. The overwhelming majority of the overall comfort ratings for these equipment items and ensembles were "bulky" and "restrictive," emphasizing once more the importance of reducing bulky items that are unacceptable in the restrictive environment of a rotary wing aircraft.

Table 4. Equipment Items and Indicated Taxon Degradation  
(A "√" indicates that more than 50% of respondents  
identified some level of performance degradation)

Equipment items	Taxon								
	VIS <sup>a</sup>	NUM	COG	FMD	FMC	GML	GMH	CRW	CORAL
Undergarment									
Tri-service coverall									
ABDU <sup>b</sup>									
Old coverall									
Mustang suit <sup>c</sup>				√		√	√		
Socks									
Liners, feet									
Boots									
NBC overshoes						√	√		
Cold weather liner, hands				√	√				
Nomex <sup>®</sup> flight glove <sup>d</sup>				√					
Cold weather glove				√					
NBC overgloves				√	√	√	√	√	
NBC mask	√	√	√	√	√	√	√	√	√
Helmet									
Side arm									
Holster									
Survival vest									
Flotation vest									
Extraction harness									
Raft					√				
Body armor				√	√	√	√		
Flight ensemble									
NBC ensemble	√	√	√	√	√	√	√	√	√
NBC +armor ensemble	√	√	√	√	√	√	√	√	√

<sup>a</sup>VIS = visual, NUM = numerical, COG = cognitive, FMD = fine motor discrete, FMC = fine motor continuous, GML = gross motor light, GMH = gross motor heavy, CRW = communications read and write, CORAL = communications oral

<sup>b</sup>ABDU = aircrew battle dress uniform

<sup>c</sup>Mustang suit: immersion suit

<sup>d</sup>Nomex<sup>®</sup>: fire-retardant properties

#### 4.5 Reasons Associated With Degraded Performance

In order to understand why the equipment items affected task performance, participants were instructed to select the reasons for the indicated time degradations and to rank order them. Unfortunately, only a few of the participants followed instructions. Most marked their reason(s) but did not rank order the reasons when more than one was chosen; therefore, for this analysis, the rank ordering was ignored. The primary reasons associated with the PDFs for referenced equipment items are listed in Table 7. When two or more reasons are

shown, frequencies were the same for each of those reasons. That is, the reasons were tied for first place.

Table 5. Equipment Items and Modal Performance Degradation Factors by Taxon

Equipment items	VIS <sup>a</sup>	NUM	COG	Taxon					
				FMD	FMC	GML	GMH	CRW	CORAL
Mustang suit				1.05		1.05	1.1		
NBC overshoes						1.1	1.1		
Cold weather liner, hands				1.1	1.1				
Cold weather glove				1.25					
NBC overgloves				1.5	1.5	1.25	1.5	1.5	
NBC mask	2	1.1	1.25	1.25	1.5	1.5	1.5	1.5	1.5
Raft					1.05				
Body armor				1.1	1.1	1.25	1.25		
NBC ensemble	1.5	1.1	1.1	1.5	1.5	1.75	1.75	1.5	1.5
NBC +armor ensemble	1.5	1.5	1.5	2	2	2	2	2	1.5

Note. The above values are multiplied by the baseline task times proportionally assigned to the respective "taxon" to obtain a degraded task time. For example, when the degraded task time is computed for the Mustang suit, since the task involves a visual component with a weighting of 0.5 and a fine motor discrete component with a weighting of 0.5, only 50% of the baseline task time (the portion attributable to fine motor discrete) would become degraded, since according to the table, the visual component of the task is not affected.

Table 6. Equipment Items and Overall Comfort Ratings

Equipment	Overall comfort rating
Mustang suit	Other
NBC overshoes	Bulky
Liners, hands	Uncomfortable; annoying; other
Cold weather glove	Bulky
NBC overglove	Bulky; restrictive
NBC mask	Restrictive
Raft	Bulky
Body armor	Bulky
NBC ensemble	Bulky
NBC + armor ensemble	Uncomfortable



Table 7. Most Frequently Given Reasons Associated With Taxon Performance Degradations

Equipment items	VIS <sup>a</sup>	NUM	COG	Taxon					
				FMD	FMC	GML	GMH	CRW	CORAL
Mustang suit				B		B	B		
NBC overshoes						B	B		
Liners, hands				A	A				
Cold weather glove				B					
NBC overglove				B	B	R	B	B,R	
Mask	R	R	A	R	R	R	R	R	R
Raft					B,U,R				
Body armor				R	R	R	R		
NBC ensemble	R	U	A	R	R	R	R	R	R
NBC + armor ensemble	R	R	U,A,R	R	R	R	R	R	R

B = bulky; A = annoying; R = restrictive; U = uncomfortable

According to the participants, the most frequently chosen reason for the performance degradations associated with specific task types caused by specific items or ensembles was "restrictive." The second reason most frequently selected was "bulky." These reasons emphasize the need to quantitatively characterize the potential adverse effects of an encumbered ensemble. Consequently, CIE and ALSE design should be particularly sensitive to the confined environment of an aircraft cockpit. Instead, some of the standard equipment and ensembles were originally designed for the land soldier who does not have the same degree of space restrictions. For aircrew, these effects can range from various levels of discomfort to reduced or unacceptable performance levels. For instance, a bulky NBC ensemble can significantly encumber the aviator as well as impair thermoregulation and heat dissipation. Efforts should be made to mitigate rather than exacerbate heat stress (Reardon et al., 1996). The complications associated with performance in extreme environments, whether attributable to hot or cold climates, can add significantly to discomfort and diminished performance capabilities. With aircraft in particular, there literally is little room for error, and the consequences of failure are especially catastrophic. An error or time delay for a task may at best result in reduced performance; at worst, it could result in the loss of life. Full frequency counts of all the reasons stated by study participants are presented in Appendix C.

#### 4.6 Analysis of Contributions of Individual Items to Ensemble Degradations

To examine the relationship between the individual items and the ensembles, an analysis was performed which resulted in the development of a weighting scheme. The NBC ensemble plus armor is composed of several of the individual equipment items (namely, the NBC mask, overgloves, overshoes, and body

armor) that were linked to degradations in task performance. Separate equations were developed that related individual contributions to the overall degradation of the NBC ensemble plus armor. For each of the nine taxons, the individual equipment items that had a degradation factor assigned were identified. If only one item was associated with that taxon, then the weight for the contribution of that item was a 1.0. For example, the only ensemble component associated with the VIS task type is the mask; therefore, the weight is 1.0. In cases when multiple individual equipment items contributed to the ensemble degradation, then those degradation factors were normalized by dividing the individual degradation factor by the sum of all the degradation factors associated with that particular taxon. For example, for the GML taxon, the degradation factors for the individual equipment are overshoes = 1.1, overgloves = 1.25, mask = 1.5, and body armor = 1.25. The individual equipment degradation amounts are summed (e.g.,  $.1 + .25 + .5 + .25 = 1.1$ ). The individual degradations are then divided by the sum in order to normalize (e.g.,  $.1/1.1 = .09$ ,  $.25/1.1 = .23$ ,  $.5/1.1 = .45$ ,  $.25/1.1 = .23$ ). The normalized values become the coefficients for the equations. The coefficient is 1.0 for cases when only one individual equipment contributed to the taxon degradation. The following equations were developed with this procedure:

$$[EQ1] \text{ VIS} = 1.0 * (\text{mask})$$

$$[EQ2] \text{ NUM} = 1.0 * (\text{mask})$$

$$[EQ3] \text{ COG} = 1.0 * (\text{mask})$$

$$[EQ4] \text{ FMD} = .58 (\text{overgloves}) + .29 (\text{mask}) + .12 (\text{body armor})$$

$$[EQ5] \text{ FMC} = .45 (\text{overgloves}) + .45 (\text{mask}) + .10 (\text{body armor})$$

$$[EQ6] \text{ GML} = .09 (\text{overshoes}) + .23 (\text{overgloves}) + .45 (\text{mask}) + .23 (\text{body armor})$$

$$[EQ7] \text{ GMH} = .07 (\text{overshoes}) + .37 (\text{overgloves}) + .37 (\text{mask}) + .19 (\text{body armor})$$

$$[EQ8] \text{ CRW} = .50 (\text{overgloves}) + .50 (\text{mask})$$

$$[EQ9] \text{ CORAL} = 1.0 * (\text{mask})$$

Ideally, protective equipment should not cause restrictions or impede performance. However, as demonstrated by this analysis, the NBC mask was the sole contributor to degradations in four of the taxons: VIS, NUM, COG, and CORAL. The NBC mask was also the greatest contributor to the GML taxon and had a relatively large impact on the GMH and CRW taxons as well.

#### 4.7 Implications of NBC Mask Results

As previously stated in this report, 100% of the questionnaire respondents ( $n = 47$ ) indicated that donning the NBC mask resulted in task performance degradation. This unanimous response suggests several important issues for the purposes of this analysis. First, it emphasizes that priority should be given to addressing the concerns associated with the NBC mask. The global proliferation of chemical weapons technology and biological warfare capabilities in recent years has greatly increased the likelihood of NBC weapons employment

(Gourley, 2000). This climate fosters very real concerns, especially for the military. Secondly, the results suggest that an additional degree of severity is potentially associated with the NBC mask in that the NBC mask had an adverse effect on all nine task types. For more details about the specific problems noted through the semi-structured group interviews, please refer to Tauson and others (1997).

Two types of NBC masks were addressed through the questionnaires in this study: the M24 and the M43. Although the PDFs were developed with the combined data set, they were also examined individually. Although the M43 is the more recently developed mask, the performance degradation ratings were not significantly different from those of the M24. Both masks were rated nearly equally in terms of the trend for the PDFs. When the task types and PDFs were rank ordered for both masks, the results were the same. The highest PDFs for both masks were associated with the VIS task type, the second highest with CORAL, and the third highest with CRW. This suggests that certain features of the NBC mask warrant more immediate attention: the optical lens, speaking device, and hearing mechanism. Although the M43 mask promised improvement<sup>3</sup> over the M24 mask in terms of better visual performance, the data show that this may not be the case because both masks had comparable estimated degradation for visual types of tasks.

Attention to improving the mask hood and helmet ear cup compatibility and the mask microphone reliability is also warranted because of the increased degradation reported for tasks involving CORAL. CRW is also affected when the visual acuity needed for these types of tasks is degraded. The types of taxon-related performance degradation indicated by the findings in this study could have a significant impact on pilot situational awareness, thus affecting communications among other crew members as well as the information shared with command and control elements and other units outside the cockpit. These NBC mask issues are not new to the mask development community; visual problems and the incompatibility of the mask lenses with optical devices on other systems and vision-correction devices are discussed in detail in reports by Harrah (1985). Problems with speech intelligibility are noted by McMahon and Stemann (1991). Data from the Joint Services Lightweight Integrated Suit Technology (JSLIST) which were gathered around 1995 conclude that mask hoods dramatically reduce the attenuation provided by the helmet because the ear cup seal is broken.

While existing information about task performance degradation in an NBC environment is limited and often anecdotal, this research provides quantitative estimates of performance degradation that can be used to focus attention on those personnel and tasks that are at greater risk. Identifying and addressing the

---

<sup>3</sup>The M24 has a windshield type of visor with reported distortion effects, whereas the M43 has spherical eyepieces or goggle-like construction.

needs of the warfighter early in system acquisition programs may result in cost-effective, streamlined, and more expeditious solutions.

---

## 5. An Example of Applying the Performance Degradation Factors

---

While the degradation factors themselves are of interest, they are designed to be applied to task time estimates, as modeled in IMPRINT. The PDFs shown in Table 5 are multiplicative values that increase the performance time of tasks that have been assigned or described by the affected taxons. As stated earlier, because these PDFs are meant to increase the time to perform, they are always greater than 1. Logically, a PDF of "1.00" would indicate no degradation and when multiplied against the time would result in no increment. The time adjustment (timadj) calculation is computed as follows:

$$\begin{aligned}\text{timadj} &= (\text{degradation factor} - 1.00) \times \text{taxon weight} \\ \text{final time} &= (1.00 + \text{timadj}) \times \text{original time (hh:mm:ss)}\end{aligned}$$

When more than one taxon is involved for a given task, the times associated with each of the taxons are weighted, degraded, and then added to obtain a total degraded time for the task. For example, the application of the PDF for the previously mentioned task *repositioning a helicopter in flight* while the NBC mask is worn would be computed as follows:

$$\begin{aligned}\text{Taxon assignment of FMC and a taxon weight of 75\% (.75)} \\ \text{Taxon assignment of CORAL and a taxon weight of 25\% (.25)}\end{aligned}$$

The degradation factors corresponding to the NBC mask equipment item and FMC and CORAL taxons are 1.5, according to Table 5. If the assumed task time is 00:01:05 (read 1 minute, 5 seconds), inserting these numbers into the following algorithm results in

$$\begin{aligned}\text{timadj} &= (\text{degradation factor} - 1.00) \times \text{taxon weight} \\ \text{final time} &= (1.00 + \text{timadj}) \times \text{original time (hh:mm:ss)}\end{aligned}$$

Since this task is composed of two taxons, FMC and CORAL, the computation is as follows:

$$\begin{aligned}\text{timadj} &= [1.5 \text{ (FMC degradation factor)} - 1.00 \text{ (constant value)}] \times .75 \text{ (FMC taxon weight)} \\ &\quad + \\ &\quad [1.5 \text{ (CORAL degradation factor)} - 1.00 \text{ (constant value)}] \times .25 \text{ (CORAL taxon weight)} \\ &= \\ &\quad .5\end{aligned}$$

$$\begin{aligned}\text{final time} &= [1.00 \text{ (constant value)} + .5 \text{ (timadj)}] \times 00:01:05 \text{ (original task time)} \\ \text{final time} &= 00:01:38 \text{ (degraded task time)}\end{aligned}$$

The degraded task time is 00:01:38 (read 1 minute, 38 seconds). Comparing the original time of 00:01:05 with the adjusted time of 00:01:38 indicates a 33-second increase in the amount of time required to perform this task when the NBC mask is worn. Since individual task degradations are aggregated across the entire mission through task network modeling, IMPRINT provides a way to model, analyze, and compare total system performance. Generally, an IMPRINT mission consists of hundreds of tasks in a complex sequencing architecture, and aggregating task time increases such as the one demonstrated previously can significantly impact whether the mission is completed within the critical time frame. This method provides a quantitative basis for comparing the effects of various types of equipment and ensures that alternatives are compared in a similar standardized manner.

These PDFs are intended to be coded directly in IMPRINT to enhance the stressor modeling capability. In the meantime, they can be accessed and applied through the use of Excel™ spreadsheets that were developed to support this effort. Once the IMPRINT model is built, task time data are pre-processed through the use of these spreadsheets. The degraded task times are then re-entered into the IMPRINT model, and through stochastic execution, an estimate of total system performance is derived. For a more thorough discussion of the development and application of the pre-processor procedure, a separate ARL technical report is being prepared (Salvi, in press).

---

## 6. Preliminary Validation of Performance Degradation Factors

---

The validation process for a selected model is not only complex but is often unique to that model. Validation, as formally defined in Army Pamphlet 5-11 (Department of the Army, 1992), involves the comparison of the model and simulation behavior and results to data obtained from another credible domain that is believed to be the real world, has been proved to closely approximate the real world, or is from a source that is recognized as expert on the relevant characteristics of the real world.

As discussed earlier in this report, IMPRINT offers a unique capability to assess human performance in the presence of five environmental stressors, one of which is MOPP. These generalizeable PDFs can be applied to any set of tasks and to any system to obtain an estimate of expected degradation. The five performance stressors embedded in IMPRINT were developed on the basis of published

research, which serves as a degree of validation. In an effort to conduct a preliminary validation of the PDFs developed explicitly for the Air Warrior program, a cursory comparison of the Air Warrior NBC ensemble PDFs with the IMPRINT MOPP degradation factors was performed.

The MOPP PDFs that are currently in IMPRINT were developed from work performed by the former Ballistic Research Laboratory<sup>4</sup> (BRL). There are three reasons why this particular data source was chosen for validation purposes. First, the data are relatively in the same format for easy comparison. Secondly, there is great similarity between the MOPP IV ensemble which includes the NBC overgarment, overboots, mask, hood, and overgloves, and the NBC ensemble worn by aircrew, which includes all the items listed plus the helmet. The third reason is that the BRL individual protective equipment (IPE) database and model were developed from empirical data, thereby providing an appropriate validation mechanism.

There were, however, some obvious differences between the two data sets. First, the BRL IPE database and model consist of data for 756 military tasks that were performed in various field exercises where groups of soldiers performed a set of tasks while wearing standard battle dress uniforms (BDUs) and MOPP IV or chemical IPE. Task performance times were analyzed for both conditions, and performance decrement factors were subsequently calculated from these empirical data. Most of these tasks were maintenance types of tasks on major Army systems, whereas the tasks of interest here are operational or mission-related pilot tasks. Another distinction is that the BRL data were derived from empirical field tests, while the Air Warrior data were developed from subjective estimates. In addition, the BRL IPE tasks were later defined in terms of ten human ability codes, instead of the nine taxons that are employed in IMPRINT. The ten human ability codes are communication skills, numerical data skills, decision-making skills, precision control skills, movement and coordination, attention and quickness, visual pattern, manual control skills, strength and stamina, and vision.

As a first step in the implementation of the original MOPP degradation factors in IMPRINT, these human ability codes were mapped to the IMPRINT taxons, as shown in Table 8. The degradation factor for each taxon was then computed as the average of the mapped degradation factors by human ability code. For this analysis, these derived IMPRINT MOPP degradation factors were compared to the Air Warrior degradation factors.

Despite the differences between these two data sets, results of the comparison were still promising. Table 9 lists the PDFs for the IMPRINT MOPP IV and the Air Warrior PDFs for two conditions, the NBC ensemble and the NBC plus armor ensemble. The Air Warrior NBC ensemble is most similar to the MOPP IV

---

<sup>4</sup> Now part of ARL

condition in terms of clothing and equipment items. Of course, an aviator has the additional encumbrance from the survival vest and helmet when he or she dons the NBC ensemble. A review of Table 9 shows that the PDFs for IMPRINT MOPP IV and the Air Warrior NBC ensemble are very similar. There is less than a 10% difference among the PDFs for most of the taxons, which exhibits a close correspondence between the MOPP IV and the Air Warrior NBC ensemble. As expected, the NBC plus armor ensemble has greater performance degradation values than either the NBC ensemble or the MOPP IV. In two of the four taxons (FMD and GML) for the NBC plus armor ensemble, the degradation factor was higher, 25% to 35% greater than the MOPP IV degradation factors. In the other two taxons (VIS and CORAL), the difference was less than 10%. A comparison of the MOPP IV data with the NBC plus armor ensemble exhibits a reasonable trend in that the most cumbersome and restrictive ensembles are associated with greater PDFs, as would be expected. Overall, the Air Warrior PDF values are somewhat conservative but are comparable to the IMPRINT data.

Table 8. Mapping of IMPRINT Taxons to BRL Human Ability Codes

IMPRINT taxons	BRL human ability codes									
	COM <sup>a</sup>	NUM	DM	VP	MC	PC	M&C	A&Q	S&S	V
VIS				X				X		X
NUM		X	X							
COG		X	X							
FMD					X	X		X		
FMC					X	X		X		
GML							X			
GMH									X	
CRW	X									
CORAL	X									

<sup>a</sup>COM = communications; NUM = numerical; DM = decision making; VP = visual pattern; MC = manual control; PC = precise control; M&C = movement & coordination; A&Q = attention & quickness; S&S = strength & stamina; V = vision

Table 9. Comparison of IMPRINT MOPP IV PDFs to Air Warrior PDFs for NBC Ensemble and NBC + Armor Ensemble

IMPRINT taxon	IMPRINT MOPP IV	Air warrior NBC ensemble	Air warrior NBC + armor ensemble
VIS	1.6	1.5	1.5
FMD	1.7	1.5	2
GML	1.5	1.75	2
CORAL	1.7	1.5	1.5



---

## 7. Conclusions

---

### 7.1 Methodology

IMPRINT offers a unique capability to assess human performance in the presence of five environmental stressors, one of which is MOPP gear. These PDFs are coded directly in the software and are easily applied to any set of tasks or to any system to obtain an estimate of expected operational performance degradation. However, this capability did not provide sufficient detail for the interests of the Air Warrior program, which required the development of an explicit set of PDFs to address the effects of specific equipment items and ensembles on performance. Although empirical data were neither available nor feasible to collect at this time, by obtaining estimates from SMEs via a detailed questionnaire, the author achieved findings similar to those obtained by group consensus. Participants were very eager to cooperate and were highly motivated to have an impact on future Army equipment. The information obtained from this survey was used to develop PDFs that will first be used as a pre-processor for the IMPRINT model and suitable for coding directly in the software. This effort proved to be a reliable and acceptable means for data collection and thus provided the vehicle for expanding the IMPRINT stressor capability. For the Air Warrior Program, this methodology demonstrated success in quantitatively characterizing subjective data into a usable means that can be applied as a standardized and generalizable modeling approach.

### 7.2 Recommendations

While this effort demonstrated success, there are many avenues to explore for future work. An interesting proposal for future efforts involves the validation of the questionnaire-derived time degradation estimates. A comparison of the data and findings derived from questionnaires to empirical data collected from either field or simulator exercises would significantly contribute to the validation of the PDFs reported here. At the very least, quantitative statistical analysis may result in the refinement and improvement of the PDFs.

Based on existing research which suggests that SMEs can more reliably provide time degradation estimates than accuracy degradation estimates (Anno et al., 1996), current efforts were focused on the development of PDFs with respect to time. Field exercise or simulator data could also be used to develop accuracy degradation factors. This would provide a means to model the effects of the CIE and ALSE in terms of the impact on accuracy of certain types of tasks. IMPRINT currently has the capability to model both time and accuracy as performance measures; therefore, once accuracy degradation data are developed, they can be easily implemented in IMPRINT.



Future efforts could also focus on defining more precisely the reasons for the equipment degradation estimates and then determining which measure of effect should be used. Instead of stating that a piece of equipment is restrictive, one should determine how it restricts (i.e., the field of view or the range of motion). By using these measures to evaluate new designs, one can derive early estimates of the new design degradations.

Also of interest would be a means to categorize effects into short-term impacts on performance attributable to restriction of motion versus longer term impacts, such as those that cause neck muscles to cramp after several hours. This would facilitate the examination of mission degradation on a time continuum. Through the current IMPRINT modeling, "high driver" tasks that are most impacted by Air Warrior equipment can be identified, and alternate methods for accomplishing those tasks can be explored.

Clearly, the work that was done in support of the Air Warrior program provides a solid foundation for some interesting future endeavors. Additionally, the methodology is adaptable enough to address similar performance degradation and modeling issues for other military programs for ground or mounted soldiers.

INTENTIONALLY LEFT BLANK

---

## References

---

- Allender, L., Lockett, J., Headley, D., Promisel, D., Kelley, T., Salvi, L., Richer, C., Mitchell, D., & Feng, T. (1994). HARDMAN III and IMPRINT verification, validation, & accreditation report. Aberdeen Proving Ground, MD: U.S. Army Research Laboratory.
- Allender, L., Salvi, L., & Promisel, D. (June 1997). Evaluation of human performance under diverse conditions via modeling technology. In Proceedings of Workshop on Emerging Technologies in Human Engineering, Testing, and Evaluation. Brussels, Belgium: NATO Research Study Group 24.
- Anno, G., Dore, M., & Roth, T. (1996). Taxonomic model for performance degradation in combat tasks (DNA-TR-95-115). Alexandria, VA: Defense Nuclear Agency.
- Badler, N., Phillips, C., & Webber, B. (1993). Simulating humans, computer graphics animation control. Oxford University Press.
- Department of the Army (10 June 1992). Army model and simulation management program (AR 5-11). Washington, DC: Author.
- Gourley, S.R. (2000). Simulating NBC on the battlefield, Military Medical Technology, 4(3).
- Harrah, D.M. (1985). Binocular scanning performance for soldiers wearing protective masks II (Technical Memorandum 14-85) Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.
- Kozycki, R. (September 1998). Developing a modeling and simulation paradigm for assessing the encumbrance of helicopter aircrew clothing and equipment, Proceedings of the Survival and Flight Equipment (SAFE) Association Conference, Phoenix, Arizona.
- McMahon, R.W., & Stemmann, K.S. (1991). Speech intelligibility with an amplified voice-mitter designed for the M40 series of protective mask (Technical Note 3-91). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.

- Reardon, M., Smythe, N. III, Hager, J.D., Helms, B., Omer, J., Freeze, M., & Buchanan, D. (1996). Evaluation of the effects of thermally stressful UH-60 simulator cockpit conditions on aviators wearing current MOPP 0 and encumbered MOPP 4 flight uniforms (ARL TM-96-38). U.S. Army Aeromedical Research Laboratory.
- Salvi, L. (in press). A procedure for the application of air warrior degradation factors to an improved performance research integration tool (IMPRINT) model. Aberdeen Proving Ground, MD: U.S. Army Research Laboratory.
- Tauson, R.A., Doss, N.W., & Harrah, D.M. (1997). Description and user acceptance reports of current U.S. Army aircrew life support equipment (ALSE) and aviator clothing and individual equipment (CIE) (ARL-MR-386). Aberdeen Proving Ground, MD: U.S. Army Research Laboratory.
- Waugh, J.D., Fatkin, L.T., Patton, D.J., Mullins, L.L., Burton, P.A., Barker, D.J., & Mitchell, D.A. (1999). Aviator behavior and performance as affected by aircrew life support and protective equipment (ARL-MR-440). Aberdeen Proving Ground, MD: U.S. Army Research Laboratory.

---

## Bibliography

---

- Barnes, J.A., Bruno, R.S., Hanlon, W.E., Harrah, D.M., Hickey, C.A., Merkey, R.P., Randall, R.B., & Shoemaker, C.M. (1983). XM30 engineering design test—Government, (Technical Memorandum 5-83). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.
- Davis, E., Wick, C., Salvi, L., & Kash, H. (1990). Soldier performance of military operational tasks conducted while wearing chemical individual protective equipment (IPE): Data analysis in support of the revision of the U.S. Army Field Manual on NBC protection (FM 3-4, BRL-TR-3155). Aberdeen Proving Ground, MD: U.S. Army Ballistic Research Laboratory.
- Dyer, R.F., J.J. Matthews, C.E. Wright, & K.L. Yudowitch (1976). Questionnaire construction manual (ARI P-77-1). Fort Hood, TX: U.S. Army Research Institute for the Behavioral and Social Sciences.
- Dynamics Research Corporation (July 1993). Final report for HARDMAN III, Version 4.0. Micro Analysis and Design.
- Dynamics Research Corporation (January 1990). Stressor Degradation Algorithms.
- Dynamics Research Corporation (1999). Enhanced performance degradation factors and upgrades for improved performance research integration tool (IMPRINT) Version 5 stressor review report, Micro Analysis & Design.
- Harrah, D.M. (1984). Binocular scanning performance for soldiers wearing protective masks (Technical Memorandum 3-84). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.
- Harrah, D.M., McMahon, R.W., Stemmann, K.S., & Kirven, L. (1991). HEL evaluation of vision-corrective inserts for the M40 protective mask, (Technical Note 4-91). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.
- Merkey, R.P., & Harrah, D.M. (1986). Rifle firing performance with three prototype XM40 protective masks (Technical Memorandum 5-86). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.

- U.S. Army Research Institute for the Behavioral and Social Sciences (19<sup>7</sup>). Questionnaire construction manual annex, questionnaires: Literature survey and bibliography (ARI 89-21). Fort Hood Field Unit, TX: Author.
- U.S. Army Research Laboratory (1998). Human Research and Engineering Directorate improved performance research integration tool (IMPRINT) user's guide Version 4.0, Aberdeen Proving Ground, MD: Author.
- U.S. Army Research Laboratory (1998). Human Research and Engineering Directorate improved performance research integration tool (IMPRINT) analysis guide Version 4.0. Aberdeen Proving Ground, MD: Author.
- U.S. Army Test and Evaluation Command (1975). Man-materiel systems questionnaire and interview design (subjective testing techniques) (TECOM Pam 602-1, Vol 1). Aberdeen Proving Ground, MD: Author.

APPENDIX A  
QUESTIONNAIRE AND INSTRUCTIONS

INTENTIONALLY LEFT BLANK



## QUESTIONNAIRE AND INSTRUCTIONS

### Estimates of the Effect of CIE and ALSE on Task Performance

Rank \_\_\_\_\_ Years in Aviation \_\_\_\_\_  
Age \_\_\_\_\_ Type of Aircraft Currently \_\_\_\_\_  
Flying \_\_\_\_\_  
Unit \_\_\_\_\_ Total Flying Hours \_\_\_\_\_  
Logged \_\_\_\_\_  
Crew Position (Pilot, Crew Chief, Other) \_\_\_\_\_

### Background

The Air Warrior Program Office is interested in understanding and predicting the effects of current and future clothing and individual equipment (CIE) and aircrew life support equipment (ALSE) items on the *performance* of the main aviation tasks in addition to looking at the problems associated with the items themselves. To support this effort, the U.S. Army Research Laboratory Human Research and Engineering Directorate is developing a computer model to predict aircrew performance when soldiers wear CIE and ALSE, both the standard, typically worn ensemble items and the additional, mission-specific items. The Air Warrior Program Office will use this information to identify and improve problematic equipment and incompatibilities with different aircraft. Your honest opinions are essential to the success of this program.

This questionnaire will obtain your estimates of the effects of wearing current CIE and ALSE items and ensembles on the performance of different types of tasks. We are also interested in why the equipment affects task performance. For example, does it take twice as long to perform a task because an equipment item is heavy? Or does it take just a little bit longer, 1.05 times as long, for example, because the item makes you feel cold?

## Instructions

We have no need to know who you are personally. Do not write your name on the questionnaire. However, we do need to know your unit and the type of aircraft you fly so that we can better understand your frame of reference.

Each page of the questionnaire deals with a particular piece of equipment which is identified in the upper left-hand corner. First, make an overall rating for the equipment item.

Based on the discussions you just participated in, items were identified as part of the standard, typically worn ensemble, or as part of a mission-specific ensemble. Next, mark whether each item is considered part of the standard or part of a mission-specific ensemble.

Nine different task types are listed on each page. These are described in more detail on the following page. For each task type (i.e., visual) please indicate whether the particular piece of CIE or ALSE, or ensemble will affect the amount of time it takes to perform such a task type. If there is "no effect" on the time, please indicate this by marking "no effect" on the time line. We expect that some of the equipment will have "no effect" on certain types of tasks. If the task type is impossible to perform, please mark "makes task impossible" portion of the time line. It is also possible that a piece of equipment may have a positive effect; if this is the case, please annotate it.

Also, please mark the reason(s) for any increase in time or write your own reason in the "other" portion. If there is only one reason, mark a "1" through the reason; if there are several reasons, please rank order them by placing a "1," "2," "3," etc., through the reasons. There are no right or wrong answers.

When you make the ratings on the mission-specific ensemble items, think about how those items affect your performance relative to the standard ensemble items. In other words, compare your performance while wearing the mission-specific ensemble items to your performance while wearing just the standard items.

When you make the ratings on the standard ensemble items, think about how any problems with those items negatively affect your performance, if they affect it at all.

If you have any questions, please ask the ARL representative for assistance. Again, your subject matter expertise and opinions are critical to the success of this program. Thank you for your cooperation.

There are nine task types listed below, along with their descriptions.

1. Visual - A visual task is one that requires using the eyes to identify or separate targets or objects. Examples would be seeing something move and then recognizing it as an enemy tank.
2. Numerical - A numerical task is one that requires performing arithmetical or mathematical calculations. Examples would be measuring an azimuth or course angle on a chart with a plotter and estimating the distance between two points on a map.
3. Cognitive (Problem Solving and Decision Making) - A cognitive task is one that requires processing information mentally and reaching a conclusion. Examples would be selecting the best route for the mission and selecting the best firing position for the HELFIRE.
4. Fine Motor Discrete - A fine motor discrete task is one that requires performing a set of distinct actions in a predetermined sequence. These actions mainly involve movement of the hands, arms, or feet and require little physical effort. Examples would be assembly and disassembly of the 30-mm chain gun and dialing radio frequencies.
5. Fine Motor Continuous - A fine motor continuous task is one that requires uninterrupted performance of an action needed to keep a system on a desired path or in a specific location. Examples would be maneuvering the helicopter in terrain flight and tracking a moving target.
6. Gross Motor Heavy - A gross motor heavy task is one that requires expending extensive physical effort or exertion to perform an action. Examples would be lifting a HELFIRE missile and loosening a very tight bolt with a wrench.
7. Gross Motor Light - A gross motor light task is one that requires moving the entire body (i.e., not just the hands) to perform an action without expending extensive physical effort. Examples would be turning to look out the side window and climbing into and out of a helicopter.
8. Communication (Read and Write) - A communication (read and write) task is one that requires either reading text or numbers that are written somewhere or writing text or numbers that can be read. Examples would be reading a checklist and writing coordinates on the knee board.
9. Communication (Oral) - A communication (oral) task is one that requires either talking or listening to another person. Examples would be giving a situation report by radio and receiving an instruction from air traffic control.

INTENTIONALLY LEFT BLANK

Overall Equipment Ratings: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

VISUAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
NUMERICAL tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COGNITIVE tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
FINE MOTOR DISCRETE tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
FINE MOTOR CONTINUOUS tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
GROSS MOTOR LIGHT tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
GROSS MOTOR HEAVY tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COMMUNICATIONS (READ & WRITE) tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COMMUNICATIONS (ORAL) tasks										
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		

EQUIPMENT ITEM #2 COVERALL

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## VISUAL tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## NUMERICAL tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COGNITIVE tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR DISCRETE tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR CONTINUOUS tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR LIGHT tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR HEAVY tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (READ &amp; WRITE) tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (ORAL) tasks

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	_____

Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_



EQUIPMENT ITEM #4 OVERGARMENT (2)

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

<b>VISUAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>NUMERICAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COGNITIVE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR DISCRETE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR CONTINUOUS tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR LIGHT tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR HEAVY tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (READ &amp; WRITE) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (ORAL) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		



	(Item is: Standard _____)	Mission-Specific _____)
1. <i>Identify the mission of the organization.</i>		
2. <i>Identify the organization's values.</i>		
3. <i>Identify the organization's strategic goals.</i>		
4. <i>Identify the organization's key performance indicators.</i>		
5. <i>Identify the organization's core competencies.</i>		
6. <i>Identify the organization's competitive advantages.</i>		
7. <i>Identify the organization's target markets.</i>		
8. <i>Identify the organization's primary stakeholders.</i>		
9. <i>Identify the organization's major risks.</i>		
10. <i>Identify the organization's major opportunities.</i>		

Overall Equipment Rating: Bulky, Hot , Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

VISUAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____	
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
NUMERICAL tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
COGNITIVE tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
FINE MOTOR DISCRETE tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
FINE MOTOR CONTINUOUS tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
GROSS MOTOR LIGHT tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
GROSS MOTOR HEAVY tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
COMMUNICATIONS (READ & WRITE) tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		
COMMUNICATIONS (ORAL) tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____	Makes Task Impossible		

## EQUIPMENT ITEM #6 SOCKS

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## VISUAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## NUMERICAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COGNITIVE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR DISCRETE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR CONTINUOUS tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR LIGHT tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR HEAVY tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (READ &amp; WRITE) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (ORAL) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## Overall Equipment Rating: Bulky, Hot , Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

Restrictive, Incompatible, Other

### Mission-Specific

39

# EQUIPMENT ITEM #8 BOOTS

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### VISUAL tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### NUMERICAL tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### COGNITIVE tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### FINE MOTOR DISCRETE tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### FINE MOTOR CONTINUOUS tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### GROSS MOTOR LIGHT tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### GROSS MOTOR HEAVY tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### COMMUNICATIONS (READ & WRITE) tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### COMMUNICATIONS (ORAL) tasks

No Effect 1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x \_\_\_\_\_  
Times as Long \_\_\_\_\_  
Makes Task Impossible \_\_\_\_\_

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

EQUIPMENT ITEM #9 OVERSHOES

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## VISUAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## NUMERICAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COGNITIVE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR DISCRETE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR CONTINUOUS tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR LIGHT tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR HEAVY tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (READ &amp; WRITE) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (ORAL) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## AFFECTS TIME TO DO

(Item is:	Standard _____	Mission-Specific _____)
-----------	----------------	-------------------------

Overall Equipment Rating: Bulky, Hot , Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
VISUAL tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
NUMERICAL tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
COGNITIVE tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
FINE MOTOR DISCRETE tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
FINE MOTOR CONTINUOUS tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
GROSS MOTOR LIGHT tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
GROSS MOTOR HEAVY tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
COMMUNICATIONS (READ & WRITE) tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										
COMMUNICATIONS (ORAL) tasks	No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____																																																																																										

Overall Equipment Rating: Bulky, Hot , Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

Restrictive, Incompatible, Other\_

### Mission-Specific

43



## EQUIPMENT ITEM #12 GLOVES (2)

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

VISUAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
NUMERICAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COGNITIVE tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
FINE MOTOR DISCRETE tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
FINE MOTOR CONTINUOUS tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
GROSS MOTOR LIGHT tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
GROSS MOTOR HEAVY tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COMMUNICATIONS (READ & WRITE) tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COMMUNICATIONS (ORAL) tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		



EQUIPMENT ITEM #13 OVERGLOVES

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## VISUAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## NUMERICAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COGNITIVE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR DISCRETE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR CONTINUOUS tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR LIGHT tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR HEAVY tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (READ &amp; WRITE) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (ORAL) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

# EQUIPMENT ITEM #14 MASKS

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

### VISUAL tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### NUMERICAL tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### COGNITIVE tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### FINE MOTOR DISCRETE tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### FINE MOTOR CONTINUOUS tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### GROSS MOTOR LIGHT tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### GROSS MOTOR HEAVY tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### COMMUNICATIONS (READ & WRITE) tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

### COMMUNICATIONS (ORAL) tasks

No Effect \_\_\_\_\_  
1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x  
Times as Long

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_  
Makes Task Impossible

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

VISUAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____		
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
NUMERICAL tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
COGNITIVE tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
FINE MOTOR DISCRETE tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
FINE MOTOR CONTINUOUS tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
GROSS MOTOR LIGHT tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
GROSS MOTOR HEAVY tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
COMMUNICATIONS (READ & WRITE) tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	
COMMUNICATIONS (ORAL) tasks												
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	_____			Makes Task Impossible	

## EQUIPMENT ITEM #16 OTHER GARMENTS

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

<b>VISUAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>NUMERICAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>COGNITIVE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>FINE MOTOR DISCRETE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>FINE MOTOR CONTINUOUS tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>GROSS MOTOR LIGHT tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>GROSS MOTOR HEAVY tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>COMMUNICATIONS (READ &amp; WRITE) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										
<b>COMMUNICATIONS (ORAL) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
Times as Long										

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

VISUAL tasks		If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____	
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
NUMERICAL tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
COGNITIVE tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
FINE MOTOR DISCRETE tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
FINE MOTOR CONTINUOUS tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
GROSS MOTOR LIGHT tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
GROSS MOTOR HEAVY tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
COMMUNICATIONS (READ & WRITE) tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible
COMMUNICATIONS (ORAL) tasks			
No Effect	1.05x 1.10x 1.25x 1.50x 1.75x 2x 3x Times as Long	_____	Makes Task Impossible

EQUIPMENT ITEM #18 HOLSTER

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

<b>VISUAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>NUMERICAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COGNITIVE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR DISCRETE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR CONTINUOUS tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR LIGHT tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR HEAVY tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (READ &amp; WRITE) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (ORAL) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		

**EQUIPMENT ITEM #19 SURVIVAL VEST**  
**AFFECTS TIME TO DO**  
 (Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

<b>VISUAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>NUMERICAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COGNITIVE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR DISCRETE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR CONTINUOUS tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR LIGHT tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR HEAVY tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (READ &amp; WRITE) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (ORAL) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		



## EQUIPMENT ITEM #20 FLOATATION VEST

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

VISUAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
NUMERICAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COGNITIVE tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
FINE MOTOR DISCRETE tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
FINE MOTOR CONTINUOUS tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
GROSS MOTOR LIGHT tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
GROSS MOTOR HEAVY tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COMMUNICATIONS (READ & WRITE) tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
COMMUNICATIONS (ORAL) tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		



EQUIPMENT ITEM #21 EXTRACTION HARNESS

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## VISUAL tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## NUMERICAL tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COGNITIVE tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR DISCRETE tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR CONTINUOUS tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR LIGHT tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR HEAVY tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (READ &amp; WRITE) tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (ORAL) tasks

1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
No Effect							

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

Restrictive, Incompatible, Other\_

VISUAL tasks										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other	
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
NUMERICAL tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
COGNITIVE tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
FINE MOTOR DISCRETE tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
FINE MOTOR CONTINUOUS tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
GROSS MOTOR LIGHT tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
GROSS MOTOR HEAVY tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
COMMUNICATIONS (READ & WRITE) tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			
COMMUNICATIONS (ORAL) tasks											
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible			

EQUIPMENT ITEM #23 BODY ARMOR

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

<b>VISUAL tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>NUMERICAL tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>COGNITIVE tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>FINE MOTOR DISCRETE tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>FINE MOTOR CONTINUOUS tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>GROSS MOTOR LIGHT tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>GROSS MOTOR HEAVY tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>COMMUNICATIONS (READ &amp; WRITE) tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	
<b>COMMUNICATIONS (ORAL) tasks</b>					If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	2x	
Times as Long				3x	

EQUIPMENT ITEM #24 ENSEMBLE (1)

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

<b>VISUAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>NUMERICAL tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COGNITIVE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR DISCRETE tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>FINE MOTOR CONTINUOUS tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR LIGHT tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>GROSS MOTOR HEAVY tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (READ &amp; WRITE) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		
<b>COMMUNICATIONS (ORAL) tasks</b>										If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible		

EQUIPMENT ITEM #25 ENSEMBLE (2)

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## VISUAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## NUMERICAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## COGNITIVE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## FINE MOTOR DISCRETE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## FINE MOTOR CONTINUOUS tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## GROSS MOTOR LIGHT tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## GROSS MOTOR HEAVY tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## COMMUNICATIONS (READ &amp; WRITE) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

## COMMUNICATIONS (ORAL) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible	If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other _____
Times as Long									

EQUIPMENT ITEM #26 ENSEMBLE (3)

## AFFECTS TIME TO DO

(Item is: Standard \_\_\_\_\_ Mission-Specific \_\_\_\_\_)

Overall Equipment Rating: Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## VISUAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## NUMERICAL tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COGNITIVE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR DISCRETE tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## FINE MOTOR CONTINUOUS tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR LIGHT tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## GROSS MOTOR HEAVY tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (READ &amp; WRITE) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

## COMMUNICATIONS (ORAL) tasks

No Effect	1.05x	1.10x	1.25x	1.50x	1.75x	2x	3x	Makes Task Impossible
-----------	-------	-------	-------	-------	-------	----	----	-----------------------

If time increases, mark reason(s): Bulky, Hot, Cold, Uncomfortable, Heavy, Painful, Annoying, Restrictive, Incompatible, Other \_\_\_\_\_

APPENDIX B

LISTINGS OF SPECIFIC EQUIPMENT IDENTIFIED WITH  
EACH GROUP INTERVIEW SESSION

INTENTIONALLY LEFT BLANK



# LISTINGS OF SPECIFIC EQUIPMENT IDENTIFIED WITH EACH GROUP INTERVIEW SESSION

## Units and Aircraft

	101st UH-60	101st AH-64	160th AH-6	160th MH-60	160th MH47
Equipment Item					
Undergarment	Army issue	Cotton long underwear	Type most worn	Nomex	Type most worn
Coverall	Nomex flight suit (old)	Flight coverall	Tri Service	Tri Service	Tri Service
Overgarment (1)	ABDU	ABDU	ABDU	ABDU	ABDU
Overgarment (2)	Light Aviators jacket	Light Tanker jacket	Old Coverall	Old Coverall	Old Coverall
Overgarment (3)	Heavy Aviators jacket	Heavy Jacket	Mustang Suit	Mustang Suit	Mustang Suit
Socks	issue (wool)	type most worn	Type most worn	Type most worn	Type most worn
Liners, feet					
Boots	Boots of choice (black leather)	type most worn	Type most worn	Type most worn	Type most worn
Overshoes				NBC Boot	NBC Boot
Liners, hands					
Gloves(1)	Nomex flight glove	Nomex flight glove	Nomex flight glove	Nomex flight glove	Nomex flight glove
Gloves(2)			Cold weather	Wool liner leather shell	Brown shell
Overgloves	Butyl rubber NBC glove				
Masks	M24	M43	M43	M43	M43
Helmet	HGU-56	IHADDS	SPH4B HGU- 56	HGU-56	HGU-56
Other Garments				NBC Overgarment	NBC Overgarment
Side Arm	9mm Beretta	9mm Beretta	9mm Beretta	9mm Beretta	9mm Beretta
Holster		SRU-21 integrated	Thigh holster	Thigh holster	Thigh holster
Survival Vest	SRU-21	SRU-21	SARVSO	SARVSO	SARVSO
Flotation vest		LPU-10	LPU-21 LPF	LPU-21	LPU-21 LPF
Extraction Harness			D ring on vest	D ring on vest	D ring on vest
Raft					Dry Suit
Body Armor		ceramic kevlar chicken plate	From Survival vest	From Survival vest	From Survival vest
Ensemble(1)	Standard flight gear	Standard flight gear	Standard flight gear	Standard flight gear	Standard flight gear
Ensemble(2)	NBC ensemble	NBC ensemble	NBC ensemble	NBC ensemble	NBC ensemble
Ensemble(3)		NBC + armor			

### Units and Aircraft (continued)

	227th AH-64	227th UH-60	110 CAV OH-58	229th AH-64	130th AH-64
Equipment Item					
Undergarment	Tee shirt & cotton briefs	Tee shirt & cotton briefs	Tee shirt & cotton briefs	Type most worn	Type most worn
Coverall	Old Coverall	Old Coverall	Old Coverall	Old Coverall	Old Coverall
Overgarment (1)	ABDU	ABDU	ABDU	ABDU	ABDU
Overgarment (2)					
Overgarment (3)	Mustang Suit				
Socks	Wool issue	Wool issue	Wool issue	Type most worn	Wool issue
Liners, feet					
Boots	Type most worn	Type most worn	Type most worn	Type most worn	Type most worn
Overshoes	NBC		NBC		
Liners, hands			Wool liner		
Gloves(1)	Nomex flight glove	Nomex flight glove	Nomex flight glove	Nomex flight glove	Nomex flight glove
Gloves(2)		Leather glove	Leather glove		Cold Weather
Overgloves	NBC	NBC Butyl rubber	NBC		
Masks	M43	M24	M43	M43	M43
Helmet	IHAADS	HGU-56	HGU-56 SPH-4B	IHADDS	IHAADS
Other Garments		Balaclava			
Side Arm	9mm Beretta	9mm Beretta	9mm Beretta	9mm Beretta	9mm Beretta
Holster	SRU-21	SRU-21	Shoulder		SRU-21
Survival Vest	SRU-21	SRU-21	SRU-21		SRU-21
Floatation vest	LPU-10	LPU-10			LPU-10
Extraction Harness					
Raft					
Body Armor	Flack Vest	Flack Vest	Chicken Plate		Chicken Plate
Ensemble(1)	Standard flight gear	Standard flight gear	Standard flight gear		Standard flight gear
Ensemble(2)	NBC ensemble	NBC ensemble	NBC ensemble		NBC ensemble
Ensemble(3)		NBC + armor	NBC + armor		NBC + armor

## APPENDIX C

FREQUENCY COUNTS FOR THE REASONS ASSOCIATED WITH  
THE EQUIPMENT ITEMS AND ENSEMBLES AND THEIR  
RESPECTIVE DEGRADATIONS

INTENTIONALLY LEFT BLANK

FREQUENCY COUNTS FOR THE REASONS ASSOCIATED WITH  
THE EQUIPMENT ITEMS AND ENSEMBLES AND THEIR  
RESPECTIVE DEGRADATIONS

Mustang Suit	FMD	GML	GMH	Overall
1 Bulky	7	9	9	4
2 Hot	1	1	3	1
3 Cold				
4 Uncomfortable	1	1	1	1
5 Heavy	1	2	2	3
6 Painful				
7 Annoying				2
8 Restrictive	1	2	2	3
9 Incompatible				
0 Other			2	5

Overshoes	GML	GMH	Overall
1 Bulky	14	11	14
2 Hot	2	1	4
3 Cold			
4 Uncomfortable	1	2	4
5 Heavy	3	2	3
6 Painful			
7 Annoying		2	5
8 Restrictive	8	6	8
9 Incompatible	5	4	5
0 Other	2	3	8

Liners, hands	FMD	FMC	Overall
1 Bulky			
2 Hot			
3 Cold			
4 Uncomfortable			1
5 Heavy			
6 Painful			
7 Annoying	1	1	1
8 Restrictive			
9 Incompatible			
0 Other	1	1	1

\*VIS: visual, NUM: numerical, COG: cognitive, FMD: fine motor discrete, FMC: fine motor continuous, GML: gross motor light, GMH: gross motor heavy, CRW: communications read & write, CORAL: communications oral

Cold Weather Glove	FMD	Overall
1 Bulky	12	9
2 Hot		
3 Cold	2	4
4 Uncomfortable		1
5 Heavy		
6 Painful		
7 Annoying	1	3
8 Restrictive	6	5
9 Incompatible	1	1
0 Other	2	3

Overglove	FMD	FMC	GML	GMH	CRW	Overall
1 Bulky	13	10	9	10	7	12
2 Hot	4	4	2	2	2	6
3 Cold	2	1		1		3
4 Uncomfortable	6	6	3	5	2	10
5 Heavy	2	2	2	2	2	1
6 Painful						
7 Annoying	7	5	4	4	2	9
8 Restrictive	12	8	10	8	7	12
9 Incompatible	8	7	7	6	4	10
0 Other	1				1	2

Mask	VIS	NUM	COG	FMD	FMC	GML	GMH	CRW	CORAL	Overall
1 Bulky	16	8	9	11	11	14	12	9	7	14
2 Hot	7	9	9	7	7	7	7	4	5	15
3 Cold	1									
4 Uncomfortable	16	13	16	12	15	10	11	13	8	26
5 Heavy	4	3	4	4	4	4	6	2	2	6
6 Painful	14	13	13	9	10	10	9	7	6	17
7 Annoying	19	15	18	8	12	9	12	14	11	20
8 Restrictive	38	17	15	26	27	29	25	29	29	28
9 Incompatible	8	5	6	6	8	8	8	9	12	14
0 Other	7	2	2	2	2	4	2	4	3	2

Raft	FMC	Overall
1 Bulky	2	4
2 Hot		
3 Cold		
4 Uncomfortable	2	2
5 Heavy		
6 Painful		
7 Annoying	1	2
8 Restrictive	2	2
9 Incompatible		
0 Other		3

Body Armor	FMD	FMC	GML	GMH	Overall
1 Bulky	15	11	19	18	20
2 Hot	1	2	2	1	5
3 Cold					1
4 Uncomfortable	9	10	11	11	13
5 Heavy	11	11	16	15	16
6 Painful	1	1	2	2	6
7 Annoying	5	5	7	7	11
8 Restrictive	19	19	25	24	16
9 Incompatible	5	4	4	6	6
0 Other			1		5

NBC Ensemble	VIS	NUM	COG	FMD	FMC	GML	GMH	CRW	CORAL	Overall
1 Bulky	14	9	9	24	24	24	23	9	6	26
2 Hot	7	9	8	12	11	14	17	6	5	24
3 Cold										
4 Uncomfortable	14	12	12	18	18	17	17	13	12	24
5 Heavy	4	4	2	4	4	5	4	1	1	10
6 Painful	8	8	8	10	10	10	8	8	5	12
7 Annoying	12	10	14	18	18	20	17	14	9	21
8 Restrictive	29	10	11	27	27	31	29	22	18	25
9 Incompatible	7	2	2	8	7	9	8	8	7	13
0 Other	2	1	1	1	1	1	1	2	4	5

NBC+Armor Ensemble	VIS	NUM	COG	FMD	FMC	GML	GMH	CRW	CORAL	Overall
1 Bulky	8	7	8	8	9	10	9	10	7	7
2 Hot	7	5	8	8	9	8	8	8	5	6
3 Cold	1		1	1	1	1	1	1	1	1
4 Uncomfortable	8	8	10	10	11	11	10	11	7	9
5 Heavy	5	6	6	5	5	6	7	7	6	7
6 Painful	6	6	7	7	8	8	8	7	5	5
7 Annoying	7	8	10	10	10	10	9	9	6	6
8 Restrictive	12	9	10	12	13	13	12	12	10	6
9 Incompatible	4	4	6	6	6	6	6	6	6	5
0 Other	1	1	1	2	2	1		1	2	2



<u>NO. OF</u> <u>COPIES</u>	<u>ORGANIZATION</u>
1	ADMINISTRATOR DEFENSE TECHNICAL INFO CTR ATTN DTIC OCA 8725 JOHN J KINGMAN RD STE 0944 FT BELVOIR VA 22060-6218
1	DIRECTOR US ARMY RSCH LABORATORY ATTN AMSRL CI AI R REC MGMT 2800 POWDER MILL RD ADELPHI MD 20783-1197
1	DIRECTOR US ARMY RSCH LABORATORY ATTN AMSRL CI LL TECH LIB 2800 POWDER MILL RD ADELPHI MD 207830-1197
1	DIRECTOR US ARMY RSCH LABORATORY ATTN AMSRL D D SMITH 2800 POWDER MILL RD ADELPHI MD 20783-1197
1	NAVAL UNDERSEA WARFARE CTR C/O DR YVONNE MASAKOWSKI 7 ACADEMY STREET WORCESTER MA 01609
1	CDR US ARMY SOLDIER BIOLOGICAL CHEMICAL CMD ATTN AMSSB RSS A R AUER KANSAS ST NATICK MA 01760
1	CREW SYS ENGINEERING DIV ATTN BRADLEY HALL NAWCAD 48110 SHAW ROAD UNIT 5 PATUXENT RIVER MD 20670-1906
1	MOTOROLA INC SSTG 8201 E MCDOWELL ROAD PO BOX 1417 ATTN L MCNINCH M/D H1250 SCOTTSDALE AZ 85252-1417
1	PEO-GROUND COMBAT SPT SYS ATTN SFAE GCSS J W MAJ DAY PICATINNY ARSENAL NJ 07806-5000

<u>NO. OF</u> <u>COPIES</u>	<u>ORGANIZATION</u>
1	HQ TRADOC DCST ATTN ATTG CF DR D TIERNEY FORT MONROE VA 23651-5000
1	GENL DYNAMICS LAND SYSTEMS ATTN TOM SMIST PO BOX 2074 MAIL ZONE 436-20-56 WARREN MI 48090-2074
1	DR JAMES BALLAS CODE 5513 NAVAL RSCH LABORATORY WASHINGTON DC 20375-5331
1	OPM CRUSADER ATTN SFAE GCSS CR E L JEE BLDG 171-S PICATINNY ARSENAL NJ 07806-5000
1	US MILITARY ACADEMY DEPT OF SYS ENGINEERING ATTN LTC MARK J DAVIS BLDG 752 4TH FLOOR WEST POINT NY 10996-1779
1	MR BRIAN BRETT SCIENCE APPL INTERNATL CORP 4031 COLONEL GLENN HWY BEAVER CREEK OH 45431
1	DR PAUL GREEN UNIV OF MICHIGAN TRANSPORTATION RSCH INST 2901 BAXTER ROAD ANN ARBOR MI 48109-2150
1	MR DAVID HOAGLAND ATTN AFRL/HECI 2210 8TH STREET WRIGHT-PATTERSON AFB OH 45433-7511
1	DR ROBERT HOLT DEPT OF PSYCHOLOGY 3072 DAVID KING HALL MAIL STOP 3F5 4400 UNIVERSITY DRIVE FAIRFAX VA 22030

NO. OF  
COPIES   ORGANIZATION

1   DR GERALD KRUEGER  
THE WEXFORD GROUP  
INTERNATL  
8381 OLD COURTHOUSE ROAD  
SUITE 211  
VIENNA VA 22182

1   MR PAUL LEWIS  
T-10-E33 RES/DST/CIHFB  
US NUCLEAR REG COMMISSION  
ONE WHITE FLINT NORTH  
11555 ROCKVILLE PIKE  
WASHINGTON DC 20555-0001

1   DR JONATHAN KAPLAN  
US ARMY RSCH INST  
ATTN PERI II  
5001 EISENHOWER AVE  
ALEXANDRIA VA 22333-5600

1   UNITED DEF LP ARMAMENT  
SYSTEMS DIV  
ATTN MS 244 R LITTLE  
4800 EAST RIVER RD  
MINNEAPOLIS MN 55421-1498

1   MS JEAN MACMILAN  
VICE PRESIDENT R&D  
APTIMA INC  
600 W CUMMINGS PK STE 3050  
WOBURN MA 01801

1   DR MICHAEL MC ANULTY  
FAA TECHNICAL CTR  
ATTN FAATC HF LAB BLDG 28  
ATLANTIC CITY AIRPORT NJ  
08405

1   MR RON NATIVIDAD  
UNITED DEFENSE LP  
1205 COLEMAN AVE  
SANTA CLARA CA 95050

1   MS LAURIE QUILL  
UNIV OF DAYTON RSCH INST  
HUMAN FACTORS GROUP  
300 COLLEGE PARK  
DAYTON OH 45469-0158

1   DR GARY PHETTEPLACE  
US ARMY COLD REGIONS RSCH  
& ENG LAB  
72 LYME ROAD  
HANOVER NH 03755-1290

NO. OF  
COPIES   ORGANIZATION

1   MR EUGENE PURVIS  
INSTRUCTIONAL SYS SPEC  
BLDG 4 SETD DOT  
FT BENNING GA 31905

1   MR ROBERT SCHWALM  
RAYTHEON COMPANY  
4133 AMBROSIA LANE  
PLANO TX 75093-6022

1   DR LING ROTHROCK  
RM 232 RUSS CTR  
3640 COLONEL GLENN HWY  
DAYTON OH 45435-0001

1   MR ANTHONY SACCULLO  
TECHNICAL ATTRIBUTES MGR  
36 PIERSON DRIVE  
WALLINGFORD CT 06492

1   DR ROBERT SMILLIE  
SPAWAR SYSTEMS CTR-SD  
CODE D44210  
53560 HULL STREET  
SAN DIEGO CA 92152-5001

1   DR SILVANUS UDOKA  
DEPT OF INDUS & SYS ENG  
419 MCNAIR HALL  
NC A&T STATE UNIV  
1601 E MARKET ST  
GREENSBORO NC 27411

1   MR BARRY TILLMAN  
PO BOX 165  
264 3RD AVENUE  
FOX ISLAND WA 98333

1   SPACE & NAVAL WARFARE SYS CTR  
ATTN D44209 LCDR K VAN ORDEN  
53245 PATTERSON RD  
SAN DIEGO CA 92152-7150

1   NAVAL SURFACE WARFARE CTR  
DAHLGREN DIV  
HUMAN ENGINEERING GRP SPEC ENG  
SECTION G531 DR D WALLACE  
17320 DAHLGREN ROAD  
DAHLGREN VA 22448-5100

1   DR DENNIS WIGHTMAN  
CHIEF ARI RWARU  
BLDG 5100  
FT RUCKER AL 36362-5354

<u>NO. OF</u> <u>COPIES</u>	<u>ORGANIZATION</u>	<u>NO. OF</u> <u>COPIES</u>	<u>ORGANIZATION</u>
1	PM AIRCREW INTEGRATED SYS ATTN SFAE AV LSE CPT J GAUTREAUX BLDG 5681 REDSTONE ARSENAL AL 35898	1	DIRECTOR TDAD DCST ATTN ATTG C BLDG 161 FORT MONROE VA 23651-5000
1	PM SOLDIER ATTN SSCPM ES COL JETTE 10401 TOTTEN ROAD SUITE 121 FT BELVOIR VA 22060	1	HQ USAMRDC ATTN SGRD PLC FORT DETRICK MD 21701
1	CDR USAAVNC DIR COMBAT DEVELOPMENTS ATTN ATZQ CDL A CPT DONIEC FT RUCKER AL 36362-5202	1	CDR USA AEROMEDICAL RSCH LAB ATTN LIBRARY FORT RUCKER AL 36362-5292
1	CDR USAAVNC DIR COMBAT DEVELOPMENTS ATTN TZQ CDM LTC LARRABEE FT RUCKER AL 36362-5202	1	US ARMY SAFETY CTR ATTN CSSC SE FORT RUCKER AL 36362
1	CDR US ARMY TRADOC ANALYSIS CTR ATTN ATRC WAC MR WILLOUGHBY WSMR NM 88002-5502	1	CHIEF ARMY RSCH INST AVIATION R&D ACTIVITY ATTN PERI IR FORT RUCKER AL 36362-5354
1	DIR FOR PERS TECHNOLOGIES DPY CHIEF OF STAFF PERS 300 ARMY PENTAGON 2C733 WASHINGTON DC 20310-0300	1	AIR FORCE FLIGHT DYNAMICS LAB ATTN AFWAL/FIES/SURVIAC WRIGHT PATTERSON AFB OH 45433
1	CDR US ARMY RSCH INST ATTN PERI ZT DR E M JOHNSON 5001 EISENHOWER AVENUE ALEXANDRIA VA 22333-5600	1	US ARMY NATICK RD&E CTR ATTN STRNC YBA NATICK MA 01760-5020
1	DPTY COMMANDING GENERAL ATTN EXS (Q) MARINE CORPS RD&A CMD QUANTICO VA 22134	1	US ARMY TROOP SUPPORT CMD NATICK RD&E CTR ATTN BEHAVIORAL SCI DIV SSD NATICK MA 01760-5020
1	HEADQUARTERS USATRADO ATTN ATCD SP FORT MONROE VA 23651	1	US ARMY TROOP SUPPORT CMD NATICK RD&E CTR ATTN TECH LIB (STRNC MIL) NATICK MA 01760-5040
1	CDR USATRADO COMMAND SAFETY OFC ATTN ATOS PESSAGNO/LYNE FORT MONROE VA 23651-5000	1	DR RICHARD JOHNSON HEALTH & PERFORMANCE DIV US ARIEM NATICK MA 01760-5007
		1	NAVAL SUB MED RSCH LAB MEDICAL LIB BLDG 148 BOX 900 SUBMARINE BASE NEW LONDON GROTON CT 06340
		1	ARI FIELD UNIT FT KNOX BLDG 2423 PERI IK FORT KNOX KY 40121-5620

NO. OF  
COPIES ORGANIZATION

1 CDR  
WHITE SANDS MISSILE RANGE  
ATTN STEWS TE RE  
WSMR NM 88002

1 STRICOM  
12350 RSCH PARKWAY  
ORLANDO FL 32826-3276

1 DR RICHARD PEW  
BBN SYSTEMS &TECH CORP  
10 MOULTON STREET  
CAMBRIDGE MA 02138

1 DR NORMAN BADLER  
DEPT OF COMPUTER & INFO  
SCIENCE  
UNIV OF PENNSYLVANIA  
PHILADELPHIA PA 19104-6389

1 JOHN B SHAFER  
250 MAIN STREET  
OWEGO NY 13827

1 US MILITARY ACADEMY  
MATHEMATICAL SCIENCES CTR  
OF EXCELLENCE  
DEPT OF MATH SCIENCES  
ATTN MDN A MAJ HUBER  
THAYER HALL  
WEST POINT NY 10996-1786

1 ARL HRED AVNC FLD ELMT  
ATTN AMSRL HR MJ  
R ARMSTRONG  
PO BOX 620716  
BLDG 4506 (DCD) RM 107  
FT RUCKER AL 36362-5000

1 ARL HRED AMCOM FLD ELMT  
ATTN AMSRL HR MI D FRANCIS  
BLDG 5464 RM 202  
REDSTONE ARSENAL AL  
35898-5000

1 ARL HRED AMCOM FLD ELMT  
ATTN ATTN AMSRL HR MO  
T COOK  
BLDG 5400 RM C242  
REDSTONE ARS AL 35898-7290

NO. OF  
COPIES ORGANIZATION

1 ARL HRED USAADASCH FLD ELMT  
ATTN AMSRL HR ME  
K REYNOLDS  
ATTN ATSA CD  
5800 CARTER ROAD  
FORT BLISS TX 79916-3802

1 ARL HRED ARDEC FLD ELMT  
ATTN AMSRL HR MG R SPINE  
BUILDING 333  
PICATINNY ARSENAL NJ  
07806-5000

1 ARL HRED ARMC FLD ELMT  
ATTN AMSRL HR MH C BIRD  
BLDG 1002 RM 206B  
1ST CAVALRY REGIMENT RD  
FT KNOX KY 40121

1 ARL HRED CECOM FLD ELMT  
ATTN AMSRL HR ML J MARTIN  
MYER CTR RM 2D311  
FT MONMOUTH NJ 07703-5630

1 ARL HRED FT BELVOIR FLD ELMT  
ATTN AMSRL HR MK P SCHOOL  
10170 BEACH RD  
FORT BELVOIR VA 22060-5800

1 ARL HRED FT HOOD FLD ELMT  
ATTN AMSRL HR MV HQ USAOTC  
E SMOOTZ  
91012 STATION AVE RM 111  
FT HOOD TX 76544-5073

1 ARL HRED FT HUACHUCA  
FIELD ELEMENT  
ATTN AMSRL HR MY B KNAPP  
GREELY HALL BLDG 61801 RM 2631  
FT HUACHUCA AZ 85613-5000

1 ARL HRED FLW FLD ELMT  
ATTN AMSRL HR MZ A DAVISON  
3200 ENGINEER LOOP STE 166  
FT LEONARD WOOD MO 65473-8929

1 ARL HRED NATICK FLD ELMT  
ATTN AMSRL HR MQ M R FLETCHER  
NATICK SOLDIER CTR  
BLDG 3 RM 341 AMSSB RSS E  
NATICK MA 01760-5020

NO. OF  
COPIES ORGANIZATION

- 1 ARL HRED OPTEC FLD ELMT  
ATTN AMSRL HR MR H DENNY  
ATEC CSTE PM ARL  
4501 FORD AVE RM 860  
ALEXANDRIA VA 22302-1458
- 1 ARL HRED SC&FG FLD ELMT  
ATTN AMSRL HR MS R ANDERS  
SIGNAL TOWERS RM 303A  
FORT GORDON GA 30905-5233
- 1 ARL HRED STRICOM FLD ELMT  
ATTN AMSRL HR MT A GALBAVY  
12350 RESEARCH PARKWAY  
ORLANDO FL 32826-3276
- 1 ARL HRED TACOM FLD ELMT  
ATTN AMSRL HR MU  
M SINGAPORE  
BLDG 200A 2ND FLOOR  
WARREN MI 48397-5000
- 1 ARL HRED USAFAS FLD ELMT  
ATTN AMSRL HR MF L PIERCE  
BLDG 3040 RM 220  
FORT SILL OK 73503-5600
- 1 ARL HRED USAIC FLD ELMT  
ATTN AMSRL HR MW E REDDEN  
BLDG 4 RM 332  
FT BENNING GA 31905-5400
- 1 ARL HRED USASOC FLD ELMT  
ATTN AMSRL HR MN F MALKIN  
HQ USASOC BLDG E2929  
FORT BRAGG NC 28310-5000
- 1 ARL HRED HFID FLD ELMT  
ATTN AMSRL HR MP  
D UNGVARSKY  
BATTLE CMD BATTLE LAB  
415 SHERMAN AVE UNIT 3  
FT LEAVENWORTH KS 66027-2326
- 1 CDR AMC - FAST  
JRTC & FORT POLK  
ATTN AFZX GT DR J AINSWORTH  
CMD SCIENCE ADVISOR G3  
FORT POLK LA 71459-5355

NO. OF  
COPIES ORGANIZATION

- ABERDEEN PROVING GROUND
- 2 DIRECTOR  
US ARMY RSCH LABORATORY  
ATTN AMSRL CI LP (TECH LIB)  
BLDG 305 APG AA
- 1 ARL LIBRARY  
BLDG 459  
APG-AA
- 1 DIR AMSAA  
ATTN AMXSY CA MR CAROTHERS  
392 HOPKINS ROAD  
APG MD 21005-5071
- 1 US ARMY EVAL CTR-NORTH  
ATTN CSTE AEC MATS  
J WINTERS  
4120 SUSQUEHANNA AVENUE  
APG MD 21005-3013
- 1 MR DAVID CARETTI  
USA ERDEC  
ATTN SCBRD RTL E5604  
5232 FLEMING RD  
APG MD 21010-5423
- 1 DIRECTOR  
US ARMY RSCH LABORATORY  
ATTN AMSRL SL SE DR E DAVIS  
BLDG 328
- 1 ARL HRED ECBC FLD ELMT  
ATTN AMSRL HR M  
BLDG 459
- 1 ARL HRED  
ATTN AMSRL HR MB  
F PARAGALLO  
BLDG 459
- ABSTRACT ONLY
- 1 DIRECTOR  
US ARMY RSCH LABORATORY  
ATTN AMSRL CI AP TECH PUB BR  
2800 POWDER MILL RD  
ADELPHI MD 20783-1197

INTENTIONALLY LEFT BLANK

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE January 2001		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE Development of Improved Performance Research Integration Tool (IMPRINT) Performance Degradation Factors for the Air Warrior Program				5. FUNDING NUMBERS AMS Code 622716 Project No. AH70	
6. AUTHOR(S) Salvi, L. (ARL)					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Laboratory Human Research & Engineering Directorate Aberdeen Proving Ground, MD 21005-5425				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Laboratory Human Research & Engineering Directorate Aberdeen Proving Ground, MD 21005-5425				10. SPONSORING/MONITORING AGENCY REPORT NUMBER ARL-TR-2311	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)  The Human Research & Engineering Directorate of the U.S. Army Research Laboratory was asked by the Program Manager for Aircrew Integrated Systems (PM ACIS) to examine the effects of clothing and individual equipment (CIE) and aircrew life support equipment (ALSE) on the performance of Army aviators. These effects were quantified in terms of the additional time needed to perform certain types of tasks as a direct result of the equipment and ensembles. Through the completion of detailed questionnaires by subject matter experts, estimates of performance were collected and analyzed, and a set of performance degradation factors was developed.  This methodology was developed in concert with the modeling tool, the Improved Performance Research Integration Tool (IMPRINT), in order to predict the effects of CIE and ALSE on mission- and system-level performance through detailed computer modeling. This methodology demonstrated success in converting otherwise subjective data into a quantifiable and generalizable modeling approach.					
14. SUBJECT TERMS Air Warrior ensembles IMPRINT performance degradation clothing equipment modeling stressors				15. NUMBER OF PAGES 80	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified		20. LIMITATION OF ABSTRACT	